Prevention of Childhood Household Injuries: A Controlled Clinical Trial

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Abstract: Injuries claim the lives of more children each year than the next six leading pediatric disorders combined, and produce injuries that require medical attention for one in three children. In the preschool age group, 91 per cent of these accidents and over one-half the resultant fatalities occur in the home.

This paper reports the results of a controlled clinical trial conducted to evaluate the implementation of a health education program intended to reduce the risk of childhood household injuries. The study population was randomly assigned into two demographically comparable groups. Only the experimental group mothers received an educational intervention consisting of a tutorial, home safety-proofing assignments, and follow-up. The homes of the two groups were later assessed for hazards during an unannounced visit by an interviewer who did not know to which group each home belonged.

A home safety score mean for the two groups was almost identical. The program stimulated heightened interest and stated intent to improve, but did not result in actual reduction of household hazards.

Active health education, as used and evaluated in this study, appears to have limited effectiveness when applied to home safety. Approaches such as "passive" measures may offer greater potential for household injury reduction. (Am. J. Public Health 67:1148–1153, 1977.)

Introduction

Accidents claim more lives of children between ages one and 15 than the next six leading pediatric disorders combined.[1] As many as one out of every three children each year will require medical attention for injuries and, among pediatric acute illnesses, accidents are second in frequency only to respiratory disease.[2] Ninety-one per cent of all injuries to children under five years of age occurred at home[3] and more than one-half of all fatal injuries to preschoolers occur in and around the home.[4, 5]

Prevention of childhood accidents is of great importance to both individuals and society but, unfortunately, has largely been either excluded from attention or treated in an inappropriate manner.[6–9] Adequate countermeasures for dealing with those preventable aspects of injury control are poorly understood and much in need of study.

The purpose of this project was to develop and evaluate an effective method of reducing the risk of childhood household injuries. Educational attention to those hazards shown in the literature to be most in need of reduction was the focus of a practical model designed to deal with this problem.

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Methods

Study Design

An experimental design based on Campbell and Stanley's "post test-only" control group design was used.[10] As applied here, this design involved participation of a consecutive group of mothers seeking care for their preschool children in a prepaid health plan clinic. These mothers were randomly allocated to an experimental and a control group. The experimental group participated in a personalized health education program to effect reduction of household hazards. One month after completion of the health education program, both experimental and control groups received an unannounced household hazard assessment and survey questionnaire by a home visitor who was unaware of whether the mother belonged to the experimental or control group. The two groups of mothers were compared with respect to their knowledge, attitudes, and behavior related to the health problem of household accidents. Using this design, significant differences could be attributed to the experimental variable, namely the educational program.

The study population were members of the prepaid Columbia Medical Plan (CMP) in the new planned city of Co-

lumbia, Maryland, located approximately mid-way between Baltimore and Washington, D.C. Data from a 1973 survey indicated that about 90 per cent of the household heads attended college, 81 per cent of the household heads were white, and the median household annual income was $19,000.

Currently, approximately 38 per cent of the population are members of the CMP with 70 per cent of the enrollees under 35 years of age and 8.6 per cent under age 5. The types and frequency of injuries in this latter group were comparable to other published series from other middle class groups, even though the socioeconomic and demographic characteristics of the study group were above the national average.

After the child completed his medical visit at the CMP, consecutive eligible mothers were asked to stop by the office of the research assistant of the project before leaving the medical building. Mothers with children who were acutely ill, had chronic debilitating illnesses, behavioral disorders, or who presented for pre-operative clearance were excluded from participation in the study. This was intended to minimize the stress of the medical visit, thereby enabling the mother to be more attentive and receptive to the safety intervention. The research assistant told mothers that: 1) participation was entirely voluntary; 2) an unannounced home inspection might be requested at some future time; and 3) if safety hazards were present, recommendations would be offered to correct this situation and in no way would deficiencies at home be used to the detriment of the mother.

Upon agreeing to participate in the project, the mothers were assigned to either an experimental (E) or control (C) group through the use of a table of random numbers. For those assigned to the E group, the first stage of a two-stage educational intervention was begun. This first stage lasted approximately 20 minutes and consisted of two approaches:

1) The research assistant discussed with the mothers the most significant problem areas in household safety relevant to the age of her child. Important risk factors that were most likely to result in an injury to the child as well as anticipatory counseling were covered. A didactic lecture was avoided by encouraging the mother to be as active as possible in this session by exploring such areas as past injury experience and perceived benefits and barriers to preventive action. Common misbeliefs as "most accidents cannot be avoided" were also addressed.

2) A booklet, designed for this project, entitled "10 Ways in 10 Days for Making Your Child Safer" was given to each mother in the experimental group. This booklet was comprehensive in providing specific recommendations to the mother for eliminating a broad range of common household child health hazards, and encouraged the mother to take active responsibility in utilizing this resource. She was instructed to work through one page of the ten-page booklet each day. Each page concentrated on one type of home injury, e.g., burns, falls, etc. The overall format was a brief exposition of the daily theme in concrete terms, followed by a check-off list with specific, practical recommendations for the mother to follow to prevent future burns, falls, etc.

Before leaving the clinic, each mother was given, free of charge, a packet of eight electric outlet covers and three kindergards, which are easily installed plastic locking devices intended to prevent children from getting into cabinets.*

The second and final stage of the educational intervention, presented to the experimental group about four weeks after the initial encounter by the same research assistant, consisted of a telephone call in which the mothers were questioned as to their involvement in the project and difficulties they incurred while trying to follow the recommendations regarding household hazard reduction. If the mother stated she had not complied with the recommendations in the booklet, the research assistant reviewed the initial discussion with emphasis on importance and motivation, to ascertain any difficulties in completing any of the tasks. If the mother had successfully completed the programmed assignment, positive reinforcement was given, and the mother was told that her child would be sent a coloring book which stressed household safety.

Approximately four weeks after the completion of the second stage, an unannounced home visit was randomly made to a sample of approximately 100 from each of the E and C groups. The home visitor had not previously participated in the project, and was not told which family belonged to which group. Thus, the home evaluation was performed in as blind a manner as possible.

At the same time, a questionnaire designed to ascertain the mother's knowledge, beliefs, and behavior regarding home injury control was administered to both the E and C groups. Every item of the questionnaire was specifically covered at least once during the safety education. Although this instrument was compiled for this study, it was based on existing behavior prevention questionnaires which had undergone previous validity and reliability testing.[11, 12]

The Household Hazard Scale

The instrument used for obtaining the dependent variable (i.e., hazards) was based on two factors: 1) degree of exposure as determined by the home inspector; and 2) degree of potential injury severity, a numerical value derived from the National Electronic Injury Surveillance System (NEISS) statistics for 1975.[13] In this system, each hazard is rated by its unique "Mean Severity Score", based on the frequency a hazard is associated with a given injury weighted by the potential severity of that injury. The extent of exposure was judged on a scale of 1–3, where 1 indicated that the given hazard was not present, 2 represented one or two hazards exposed in the home, and 3 meant three or more hazards were exposed in the home.

Eleven potential hazards, each covered in the safety booklet, were arbitrarily selected for evaluation. Each of these 11 items (see Table 2) had a final score formulated by multiplying the degree of exposure by its logrithmically transformed mean severity score (in order to normalize the means). The individual final scores were added, yielding a

*Results of compliance using these safety devices will be the basis of a future communication.

TABLE 1—Comparison of Characteristics of the Experimental and Control Groups.

	Experimental	Control	Std Dev	P value using x^2	Significance
	(N = 101)	(N = 104)			
Age of Mother	median = 30 yrs.	median = 30 yrs.	4.2	0.54	NS
Work Status of Mother	85% unemployed	76% unemployed	0.6	0.25	NS
Number of Children per family	median = 2	median = 2	0.8	0.66	NS
Marital Status	100% married	99% married	0.1	0.25	NS
Type of Dwelling	91% lived in house or townhouse	97% lived in house or townhouse	0.6	0.11	NS
Duration of Membership in the Columbia Medical Plan	median = 30 mo.	median = 34 mo.	22.97	0.31	NS

cumulative safety index for each home. The higher the score, the greater were the existing hazards. The scale, as applied in this study, achieved an inter-observer reliability pre-test of 83 per cent.

Results

Of the 330 consecutive mothers eligible to participate in the project, only 22 declined to participate, giving a consent rate of 93.3 per cent. The youngest child in most (approximately 75 per cent) of the participating families was under three years of age. During the project, only three (0.9 per cent) dropped out, all at the time of the home visit. Initially, each group had approximately 150 members. During the four months of the data collection, several families moved and were then dropped from the study. Of those remaining eligible, 101 from the E group and 104 from the C group were arbitrarily chosen for final outcome measurements.

Table 1 shows that both groups were comparable in those sociodemographic variables thought to be most relevant. As a non-parametric analysis in Table 2 illustrates, there was a quantitatively similar hazard exposure for both groups. The fact that no differences at the p = .05 level were revealed permitted the data to be expressed in the manner shown in Table 3. Use of the Household Hazard Scale reveals that there is no difference in final scores, both in the number of individual hazards and in the total household safety scores for each of the 11 items mentioned in the safety booklet.

Data from the questionnaire revealed that of the 101 mothers in the E group, only four completed all the recommendations in the safety booklet, 71 completed some of the safety proofing, and 22 mothers did not use the booklet.

Table 4 addresses the issue of possible discrepancies between answers to questions which ask if the hazard is present, and its actual presence as determined by the home inspector. Since correlations were done only on those four items presented in Table 4, conclusions regarding the reliability of responses are tentative. Mothers were inaccurate in reporting the presence or absence of cleaning materials under the kitchen sink, but answers become highly correlated in reponse to questions related to the presence of kitchen knives, matches, lighters, and electric outlet covers.

In all instances, answers on the questionnaire revealed no difference in accident-related preventive behavior and knowledge of household accidents. Thus the interest that most mothers in the E group claimed to have had in the proj-

TABLE 2—Number of Homes Having Specified Quantity of Observed Hazards.

Type of Hazard	None*		1—2**		3 or more***	
	Experimental	Control	Experimental	Control	Experimental	Control
Cleaning Agents	1	0	7	9	93	95
Prescription Drugs	22	20	34	38	45	45
Waxes and Polishes	51	40	44	57	5	5
Non-Prescription Drugs	1	3	12	16	88	85
Coins	30	47	27	18	44	37
Jewelry, Watches & Keys	13	14	41	45	47	45
Appliances on Counter Tops	2	4	76	77	23	23
Matches Exposed	47	43	27	34	27	26
Pins and Needles	33	31	36	33	32	38
Kitchen Knives	32	38	38	34	30	30
Hazards on Floor	69	72	19	16	12	13

* hazard not present
** 1 or 2 hazards exposed in the home
*** 3 or more hazards exposed in the home
Note: Wilcoxin Rank Sum Test comparing experimental and control groups revealed no statistically significant differences at the p = .05 level.

TABLE 3—Item Analysis of Presence of Hazard Determined on Home Visit.*

	Experimental (Mean) N = 101	Control (Mean) N = 104
Cleaning Agents	8.73	8.74
Prescription Drugs	6.68	6.73
Waxes and Polishes	4.64	5.01
Non-Prescription Drugs	8.55	8.37
Coins	6.38	5.73
Jewelry, Watches, Keys	4.67	4.60
Appliances on Counter Tops	4.42	4.35
Matches Exposed	3.60	3.70
Pins and Needles	2.00	2.15
Kitchen Knives	2.03	2.02
Hazards on Floor	1.50	1.59
Total Household Hazard Scores	53.20	52.99

* Refer to text for explanation of scale.
Note: Use of student's t = test revealed non-significant differences at the p = .05 level.

ect did not relate to subsequent preventive behavior. The educational program also had little effect on belief, except for one item in which the experimental mothers *thought* that their homes were safer as a result of their participation in the study. Direct observation proved this to be a misperception.

Discussion

Because of problems of prevalence, feasibility, and multiple variables, the presence of household hazards was used as a proxy measure of injuries. Literature review provides research support for a linkage between a reduction of hazards and a reduction of injuries.[14, 15] For example, it has been well demonstrated that child-resistant containers can prevent poisoning;[16] placing slats closer together on cribs can prevent strangulation;[17] banning dangerous toys can reduce the incidence of toy-induced injuries;[18] and protecting children from space heaters and open fireplaces can reduce accidental burns.[19] Indeed, a near consensus of expert opinion is reflected in the final report of the National Commission on Product Safety: "A significant number of accidents could have been spared if more attention had been paid to hazard reduction."[18]

There are divergent theories of the best approach to injury control, but most strategies incorporate, to varying degrees, the need for modification of human behavior through health education. Difficulties at arriving at a unified approach include the multiplicity of dynamic variables involved as well as the confounding observation that what works for some patients and problems does not work for all.[20]

Some investigators stress the importance of more intensive and comprehensive management of the "accident repeater."[21] Although this strategy may be appropriate in certain individual situations, it would not seem to be cost-effective as a leading countermeasure in injury control since repeaters and accident prone children represent only a small minority of at-risk children. From April 1975 to March 1976, less than 2 per cent of the children enrolled in the CMP had more than two reported injuries of any type.

Other investigators advocate passive measures as the best approach and recommend legislation for mandatory safety standards.[7] The two most cogent arguments for this approach are: 1) the manifest effectiveness (e.g., safety caps on medicine bottles prevent many ingestions); and 2) a lesser need for individual action and responsibility, both of which are very difficult to motivate.[22]

Still other investigators stress innovative health education approaches as an effective means of improving patient behavior.[23] However, too often in practice, "education" has been operationalized as mass dissemination of information and platitudes by such means as pamphlets, films, and displays.

Why did the educational intervention used in this study fail so completely? Since Columbia, Maryland is hardly an

TABLE 4—Mothers' Responses on the Questionnaire Correlated with the Actual Presence of the Hazard as Determined by the Home Inspector.

			Hazard Observed by Inspector							
			Cleaning Agents Under Sink		Kitchen Knives on Kitchen Counter		Matches/Lighters Lying around House		Usage of Electric Outlet covers	
			Present*	Absent	Present	Absent	Present	Absent	Present	Absent
Hazard Perceived by Mother	Experimental	Yes	53	1	20	3	37	7	38	1
		No	47	0	47	29	19	40	41	11
		Level of Significance**	P = .31		p = .05		p < .001		p < .01	
	Control	Yes	61	0	11	7	37	11	48	5
		No	40	0	51	30	21	32	38	15
		Level of Significance**	P = 1.0		p < .001		p < .001		p < .05	

* Since the purpose of the table is to show discrepancies, the presence of *any* number of hazards is recorded as being present.
** The Kappa Statistic, although not widely used, is the most appropriate test to use when correlations are examined (29).

average city, could the home safety practices there be exceptionally high? After the data were collected, this possibility was tested by having the same home visitor make an unannounced visit to ten random homes located in middle class communities in Baltimore and in a rural town in Pennsylvania. The home hazard scores of these ten homes (mean of 53.0) were comparable to that of the study sample, suggested that the issue of generalizability was not a significant problem in this study.

In those instances in which health education has been shown to be effective, there was usually a well defined target population and the thrust was to modify a single focused behavior.[24, 25] In the current study, on the other hand, many behaviors were required to be changed simultaneously. Consequently, both the impact of the message and expectancy of the action were likely diluted.[26] Thus health education is less likely to be effective when applied to as broad a field as household injury control. Even if the study were successful in terms of a more restricted goal such as electric burn prevention by the use of electric outlet covers, it is doubtful whether all household accidents would have been reduced significantly.

Another important finding relates to the credibility and method of evaluation. Most outcome studies of this nature have used only written or verbal responses and accepted their accuracy. However, if correlation between the reporting and the actual "in vivo situation" is absent or erratic, then both the choice of evaluative methodology and the validity of the interpretation may be suspect. The fact that the E group mothers believed that their homes were safer as a result of their participation in the study was either a misperception or an attempt to respond in a way they thought was expected of them. Whatever the reason, it serves to replicate similar alterations of self-perceived actions found in other studies.[27, 28] This study also revealed inconsistencies in the reporting of hazards on questionnaires. The explanation of why the misperception was limited to only cleaning agents under the sink remains obscure.

Another health education strategy, or a shift of emphasis in the one employed, might have been more successful. Although unlikely to have had important bearing on the results, several other potential methodologic problems should be mentioned: 1) dissemination of the safety message from the E group to the C group; 2) extraneous intervening variables; 3) validity of the Household Hazard Scale; and 4) the post test-only experimental design might have masked differences in baseline measurements.

Implications

National and local health workers should use approaches which seem to have the greatest potential payoff. In the field of injury control, passive measures such as well-conceived construction and product safety regulations are more effective than attempts at changing human behavior. Spending hundreds of millions of dollars to broadcast ineffective health messages and platitudes, as has happened so often in the past, hardly seems worthwhile. New approaches should be evaluated on a demonstration basis prior to widescale implementation. This strategy seems self-evident, but probably most health education campaigns in the past have been carried out before their effectiveness had been established. In any event, for many injury control areas, the strategy with the greatest chance for success is one in which a modification in behavior is minimized. It is the "passive measures" approach that should receive most attention both in current emphasis and future research.

REFERENCES

1. Wheatley, G. M. Childhood accidents 1952–72: An overview. Ped. Annals 2: 10–30, 1973.
2. California Department of Public Health: Home Safety (Monograph) Final Report 1953–1957, 1957.
3. Tokuhata, G. K., Colflesh, V. G., Digon, E., et al. Childhood Injuries Associated with Consumer Products. Academic Press, 1974, pp. 245–267.
4. Accidental Facts 1975 Edition. National Safety Council, Chicago, IL 60611.
5. Kravitz, A. Accident prevention research. Ped. Annals 2:47–53, 1973.
6. Freeman, F., Goshen, C. E., King, B. G. The Role of Human Factors in Accident Prevention. U.S. Department of Health, Education, and Welfare, Public Health Service, August 1, 1960.
7. Haddon, W. and Baker, S. P. Injury Control. Draft of a chapter for Preventive Medicine, 2nd edition. Edited by D. W. Clark, B. MacMahon. Boston: Little, Brown and Company. (Not yet in press.)
8. Robertson, L. S., Kelley, A. B., O'Neill, B., et al. A controlled study of the effect of television messages on safety belt use. Am. J. Public Health 64: 1071–1080, 1974.
9. Meyer, R. Childhood injury and pediatric education: A critique. Pediatrics (Supplement) 44: 865–869, 1969.
10. Campbell, D. T., Stanley, J. C. Experimental and Quasi-Experimental Designs for Research. Chicago: Rand McNally, 1966, pp. 13–26.
11. Becker, M. H. Health Belief Questionnaire. Department of Pediatrics, Johns Hopkins Hospital, Baltimore, MD, 1972.
12. Manheimer, D. I., Mellinger, G. D., Dewey, J. Methodology of the Childhood Accident Epidemiology Project. State of California, Department of Public Health, Family Research Center, 1966.
13. NEISS News. A U.S. Consumer Product Safety Commission Publication, Volume 4, Number 2, October, 1975.
14. Susser, M. Causal Thinking in the Health Sciences. New York, London and Toronto: Oxford Press, 1973.
15. Haddon, W., Suchman, E. A., Klein, D. Accident Research Methods and Approaches. New York, Evanston, and London: Harper and Row, 1964, p. 597.
16. Barry, P. Z. Individual versus community orientation in the prevention of injuries. Preventive Medicine 4:47–56, 1975.
17. Bass, M. Asphyxial Crib Death. N. Engl. J. Med. 296: 555–556, 1977.
18. National Commission on Product Safety. Final Report 1970. U.S. Government Printing Office, Washington, D.C. 20402.
19. Brown, E. W. Space heater hazards. N. Engl. J. Med. 265:794–795, 1961.
20. Green, L. W. Cost Containment and the Economics of Health Education in Medical Care. Presented at the American Health Congress, Chicago, August, 1974.
21. Manheimer, D. I., Mellinger, G. D. Personality characteristics of the child accident repeater. Child. Dev. 38:2, June, 1967.
22. Baker, S. P. Determinants of injury and opportunities for intervention. Am. J. Epid. 101: 98–102, 1975.
23. Green, L. W. Toward Cost-Benefit Evaluations of Health Edu-

cation: Some Concepts, Methods and Examples, Health Education Monographs, 2:34–60 (suppl) 1974.
24. Ibid. pp. 49–53, 1974.
25. Rosenberg, S. G. Patient education leads to better care for heart patients. H.S.M.H.A. Health Reports 86: 793–802, 1971.
26. Green, L. W. Evaluation and measurement: some dilemmas for health education. Am. J. Public Health 67: 155, 1977.
27. Baltimore, C. and Meyer, R. J. A study of storage, child behavior, traits, and mother's knowledge of toxicology in 52 poisoned families and 52 comparison families. Pediatrics (Supplement) 44:816–820, 1969.
28. Sobel, R. Traditional safety measures and accidental poisoning in childhood. Pediatrics (Supplement) 44: 811–816, 1969.
29. Fleiss, J. L. Statistical Methods for Rates and Proportions. New York: John Wiley and Sons, 1973, pp. 146–147.

ACKNOWLEDGMENTS

The authors wish to acknowledge the many thoughtful suggestions of Susan Baker and Drs. Lawrence Green, Geoffrey Gibson, and Barbara Starfield throughout the duration of this project. This work was supported through EMS Research Grant 1 PO1 HS 01907-1 from the National Center for Health Services Research and the Robert Wood Johnson Clinical Scholars Program of The Johns Hopkins Medical Institutions. This paper was presented in part at the Ambulatory Pediatric Association meeting in San Francisco, April 25, 1977.

Conference on Housing for the Aged Announced

A national conference entitled "Community Housing Choices of Older Americans" will be held April 5-7, 1978, at the Benjamin Franklin Hotel, Philadelphia, PA. Sponsored by the Philadelphia Geriatric Center, tentative conference topics will include, but not be limited to, the following:

- Characteristics of the non-programmic housing environment of US households headed by all persons age 65+;
- Housing characteristics of priority subgroups;
- Evaluation of and projected need for programs and services which allow older persons to maintain and remain in their current residence;
- Proposed and current community housing options and alternatives; and
- Influencing future policy issues—successful approaches to translating research findings into legislation.

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